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Factors affecting the success of highway construction projects: the case of Malaysia

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Abstract. Highways are often high-risk projects due to its importance to a nation's economic, societal, and political development. Therefore, highway projects need to be successful. Numerous researchers have identified the key factors affecting their local highway projects to identify opportunities for improvements. However, the current body of literature lacks that type of information in regards to Malaysia's construction industry. This study's objective is to identify factors that are affecting Malaysia's highway projects from industry practitioners' perspective. To achieve this objective, interview data with highway project managers are analyzed. Eleven factors affecting the success of highway projects in Malaysia were identified. The factors are: workflow for the design process, competencies of project managers, availability of workforce, availability of materials, availability of equipment, weather, site location, involvement from upper management, support from clients, public acceptance, and efficiency of authorities. This study contributes to the current body of knowledge by providing researchers and practitioners with a set of alternative factors that are affecting highway project success. The lesson of this study would help the industry to promote project success of highway projects in Malaysia.

1. Introduction

Highways are public roads that connect cities or towns. Highways play a significant role in a country's development as these infrastructures are suggested to have positive correlations towards economic activities by allowing the rapid delivery of people and goods to meet regional demands [1, 2]. Furthermore, compared to other construction projects, highway projects are often inevitably recognized as high-risk projects due to its importance to a nation's economic, societal, and political development [3]. While being highly visible to the public, these projects are only established as successful if and only completed within the allocated time and budget, meets predetermined requirements and objectives, and cause minimal disruptions to the environment [4]. While governments are pushing for successful highway projects because of its importance, highway projects are negatively affecting Malaysia's economic growth from delays and cost overruns [5]. Therefore, highway projects need to meet these success criteria to ensure project success.

While ensuring project success is vital, various factors can hinder the progress of highway projects including unsettled project funding, lack of project planning, and errors or omissions in construction work [6]. Until now, researchers from numerous countries are identifying the key factors affecting their local highway projects to have a thorough understanding of their nation's construction industry including in Egypt, Cambodia, and Kenya [7, 8, 9]. However, the current body of literature lacks that type of information in regards to Malaysia's construction industry. Understanding the factors affecting



local highway projects can assist researchers and industry practitioners in identifying opportunities for improvement. Especially, overcoming the key factors may help highway projects avoid unnecessary complications and unwanted misfortunes. Therefore, it is necessary to explore the factors that are affecting Malaysia's highway projects.

The objective of this paper is to identify factors that are affecting Malaysia's highway projects from industry practitioners' perspective. The authors address this objective by analyzing individual interviews with project managers that are managing highway projects throughout Malaysia. In addition to providing additional insights into the existing highway construction body of knowledge, the findings of this study also offer references for assisting researchers and practitioners in promoting highway construction project success.

2. Background

2.1. Factors affecting Highway Projects

Topics related to highway projects have been investigated by researchers and practitioners from both the construction project management and highway transportation researchers field. Studies have determined the key factors that are recurring in their local highway projects [7, 8, 9]. For example, in Kenya, the top factors affecting highway projects include late payment by clients, slow decision making and bureaucracy in the client organization, inadequate planning and scheduling, and rain [9]. While in Egypt, the top factors are political situations, segmentation of the west bank causing limited movements between areas, owner awarding projects to the lowest bidder, delays in progress payment by owners, and shortage of equipment [7]. The top factors for highway projects in Cambodia are rain, flood, land acquisition, owner awarding projects to the lowest bidder, and equipment breakdowns [8]. In other words, although these studies provide insights into the factors affecting highway projects, the results also illustrate that different factors are affecting the local construction sector. Therefore, exploring the factors that are affecting local highway projects is essential.

2.2. Highway Projects in Malaysia

In Malaysia, researchers have explored various topics related to highway projects including critical success factors for private-public partnership, assessments for privatization, processes for managing knowledge, and green behavior of project team members [10, 11, 12, 13, 14]. A prior study has identified the causes of delays in highway projects of Malaysia through a questionnaire survey including improper planning, weather, poor site management, inadequate site investigation, and inappropriate underground utilities [15]. However, the study may not capture additional factors that might affect the industry nor acquire in-depth insights from the industry practitioners because questionnaire surveys are standardized and inflexible to changes throughout the data collection. On the contrary, although findings from individual interviews have difficulties in generalization, the approach provides opportunities to acquire unique perspectives, practical knowledge, and experiences from research participants. Therefore, to provide additional insights to this topic that might not be captured from the questionnaire survey, this study identifies factors that are affecting Malaysia's highway projects through individual interviews with industry practitioners.

3. Methods

The data collection involves acquiring qualitative data from individual interviews with highway project managers. The qualitative data are analyzed using the thematic analysis method. The subsequent subsections describe this study's data collection, and data analysis approaches.

3.1. Data Collection

This study collects data on factors affecting highway projects through open-ended interviews with project managers. Contrary to questionnaire surveys, individual interviews allow investigators to explain, better understand, and explore respondents' opinions and experiences. Furthermore, open-ended questions encourage participants to contribute as much detailed information as they desire [16].

Therefore, project managers are purposefully interviewed using these approaches to acquire their unique perspectives, practical knowledge, and experiences on the topic.

The target population of this study is project managers from highway construction companies that hold a Construction Industry Development Board (CIDB) grade G7 license. In Malaysia, organizations in other license categories are not entitled to undertake any construction projects which exceeds the predetermined value of the construction works in the registration grade. For example, the next highest rank, G6 licensed companies are only allowed to undertake projects not exceeding MYR 10 million (around USD 2.5 million). However, companies with grade G7 license are permitted to take any construction projects without restrictions. Therefore, this research purposely selects project managers from grade G7 highway construction companies because most major highway projects exceed that MYR 10 million threshold.

The individual interviews start with an introduction to the topic and open-ended question. The question introduced to the participant is: What challenges do you usually face in your highway projects? In addition to that question, additional open-ended questions are provided to the participants based on responses received. The follow-up questions aimed to obtain a deeper understanding of the information collected and to clarify whether the participants' statements were understood correctly. If the participant was unable to respond or elaborate on the questions asked, the interviewer tried to rephrase the interview question in another way and gave time for a response. The interviewer encouraged the participants to continue if they had started on an answer without finishing their explanation. After each interview, the discussions are summarized and sent to the participants for validation. This study's data collection involves interviewing sixteen valid respondents.

3.2. Data Analysis

The data analysis consists of performing the thematic analysis to identify patterns from the interview data because the approach can assist in making sense of qualitative data [17]. This method has been employed by Rahman and Ayer [18] and Radzi et al. [19] to analyze qualitative data associated with construction management topics.

The thematic analysis was conducted based on the six phases described in Braun and Clarke [17]. The first phase is becoming familiarized with the data. The authors transcribed the interview data, read, reread, and noted the initial ideas. The second phase is to generate the initial codes. The authors coded for as many potential themes and patterns as possible from the data. The authors then reviewed, discussed, and agreed on any additions and/or changes to the coding. The third phase is to search for themes based on the initial codes. During the process of creating the themes, the authors frequently revisited the codes from the second phase and the original data from the first phase. The fourth phase is to review the themes. To ensure saturation of the data, the authors continually reviewed the subthemes, defined and refined them, checking if themes work to the coded extracts and the entire data set, and reviewing data to search for additional themes. The fifth phase is to define and name the themes. The authors continually went back and forth between the themes, codes, and transcription of the interview to ensure that the themes were true to the independently coded responses. The final phase (sixth phase) is to report the output of the analysis.

4. Results and Discussion

Figure 1 summarizes the factors affecting the success of highway projects in Malaysia that were identified by analyzing individual interview data with sixteen project managers of highway projects in Malaysia. In this study, the factors are themed into internal and external factors from a project manager's perspective. In other words, the internal factors include variables that are usually actionable by project managers (e.g., shortage of equipment that can be improved through resource management processes). Conversely, the external factors are those that often uncontrollable by project managers (e.g., delays in progress payment by clients). The internal factors include variables related to process,

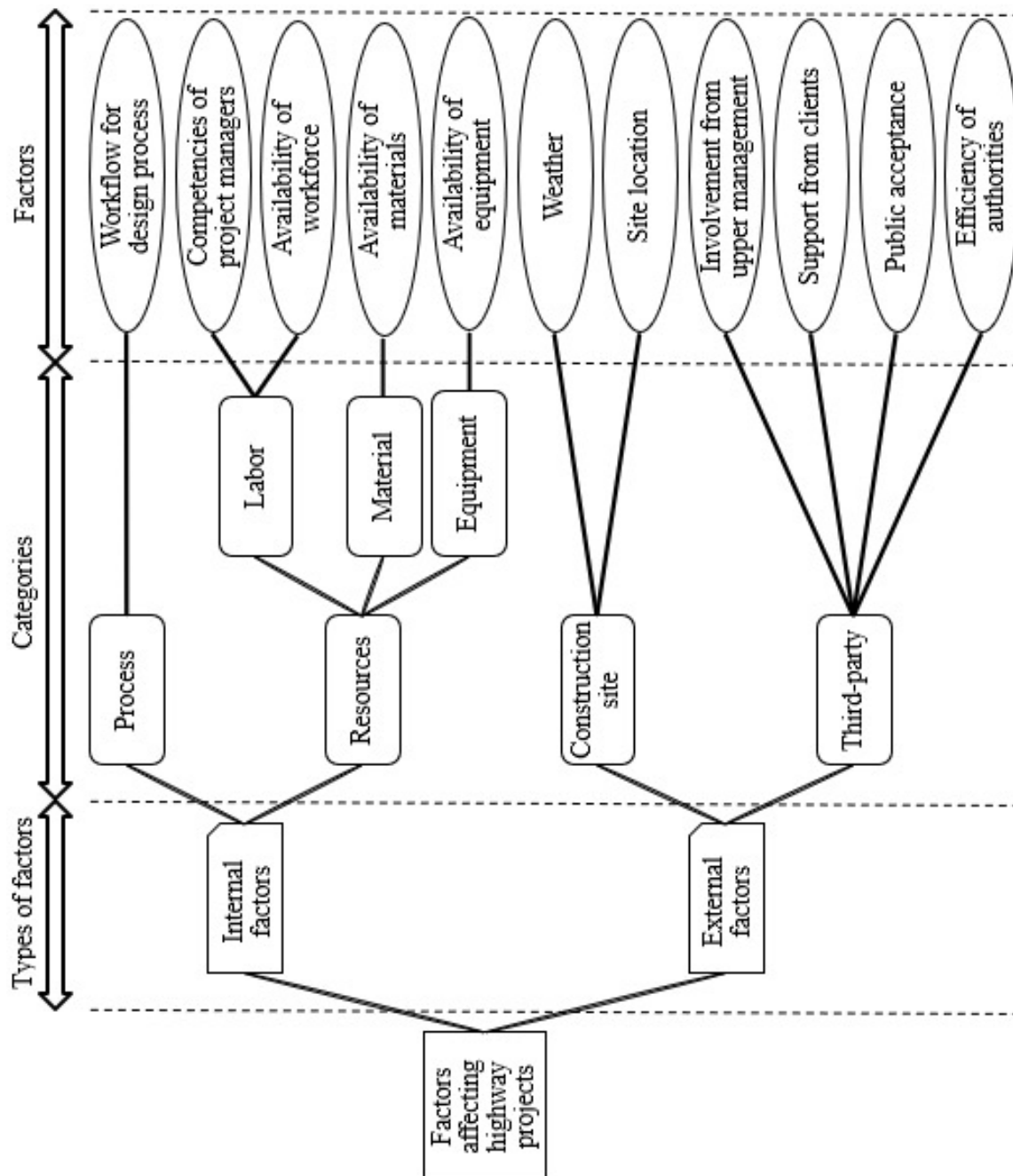


Figure 1. Overview of the factors affecting the success of highway projects in Malaysia

labor, material, and equipment, while the external factors consist of variables associated with the construction site and third-parties. These variables are further described in the subsequent subsections.

4.1 Internal Factors affecting Highway Projects

4.1.1. Process-related internal factors. Factors in this category include workflows for the design process. Several participants suggested that projects without an effective workflow for the design process usually have drawings that are incomplete, inaccurate, or not finalized that can result in incomplete construction documents for project execution. In addition to incomplete documents, the process of reviewing the documents and issues associated with project planning that are caused by these documents can also cause work idling by contractors and their project team members. Participants also suggest that the effective workflow is specifically crucial to ensure minimal disruptions since designs in highway projects keep changing throughout the project. Also, it is suggested that with an effective workflow, human errors in the design process can be reduced.

4.1.2. Labor-related internal factors. Human-related internal factors in this study involve competencies of project managers and the availability of workforce. Participants suggest that the competencies of project managers play a significant role in ensuring the success of highway projects. Specifically, project managers are suggested to possess skills to solve issues all sorts of issues and problems at construction sites, manage numerous people and various types of individuals, and plan and schedule projects. While most of these skills can be associated with soft skills or people skills such as analytical and problem-solving, communication, teamwork, and planning and organizational [20], participants also suggest that project managers should possess knowledge on highway construction to be effective. Therefore, these results illustrate that the competencies of project managers are affecting the success of highway projects.

Also, having an adequate workforce is suggested to play a crucial role in ensuring project success. Generally, highway projects in Malaysia are reported facing a shortage in labor because the local citizens are not interested in joining the construction industry since the work is dirty, dangerous, and difficult. While employing foreign workers is a plausible option, acquiring working permits from the authority is somewhat challenging since there are specific requirements that need to be fulfilled. Therefore, having the necessary amount of the workforce is a challenge for highway projects, especially in large-scale projects that require a higher number of individuals. In addition to the labor shortage, participants also suggest that highway projects are having difficulties in acquiring individuals with adequate skills, knowledge, and abilities for the workforce. This situation increases the challenge of having a proper workforce in highway projects.

4.1.3. Material-related internal factors. Factors for material-related internal factors involves the availability of materials during construction. While theoretically materials should be that instant during construction, highway projects are suggested to face difficulties in having those materials right on time due to several reasons including absence of the required materials in local markets, suppliers unable to provide the materials due to material shortages, unreasonable pricing for monopolizing practices, and insufficient ground transportation to deliver materials to the site. While projects can opt to obtain materials from international markets, this approach is suggested to have a higher risk due to fluctuation in currencies.

4.1.4. Equipment-related internal factors. Similar to materials, equipment-related internal factors involve the availability of the resource (in this case, equipment and machinery) during construction. While some may suggest that machinery breakdowns are unavoidable, project managers can avoid equipment obsolescence by ensuring proper operation, performing preventive maintenance adequately, and continually monitoring equipment [21]. In addition to equipment failures, several participants suggested that there are also project with inadequate equipment or machinery. Therefore, project managers should ensure to have a proper equipment management system to promote success in highway projects.

4.2. External Factors affecting Highway Projects

4.2.1. Construction-site related external factors. From the analysis of individual interviews with project managers, factors of site situation that affects the success of highway projects in Malaysia include the weather and site location. First, in addition to slowing down and delaying the workforce from working, the rain has a stronger influence on highway projects compared to building projects because highway projects are more sensitive towards rainwater. Therefore, weather plays a significant role in the success of highway projects, which is also suggested by prior studies including the study on the causes of delay of highway projects in Malaysia [15, 9].

Next, respondents suggest that site location can heavily influence the work progress of highway projects. For example, highway projects that involve areas that are challenging for construction, such as terrains that are hilly or rocky are more demanding compared to those with typical terrains during earthmoving and avoiding drainage issues. Also, terrains that are forestry or swampy areas are less accessible. Furthermore, highways that cross rivers or lakes are challenging because they involve constructing bridges. While these challenges can be associated with highway projects in rural areas, construction sites in urban areas also have their challenges including difficulties in acquiring permits from authorities, managing traffic, relocating underground utilities and services, and setting up storage areas. Also, regardless of a project being in urban or rural areas, the distance between sites and the nearest quarry can affect success due to issues associated with accessibility and cost. In other words, in addition to challenges that emerge from different site conditions caused by poor site investigation [15], site location can affect highway projects in various ways.

4.2.2. Third party-related external factors. Third parties that are suggested to affect the success of highway projects include the upper management, clients, the public, and authorities. Top management can influence success by ensuring projects have front monies for the project before funds from progress payments are available (i.e., financial support), and visiting the sites to provide feedback and motivation to project team members (i.e., emotional support). Also, management can promote project success by ensuring that projects have an adequate number of labor with the appropriate skills. One approach to achieve that includes having responsible parties to identify gaps in the competencies of individuals that will be involved in the project.

Conversely, another third-party that is indirectly involved in the projects – clients can support projects by paying progress payments on time and providing constructive feedback to avoid unnecessary stress among project team members. Conversely, third-parties that are indirectly involved in highway projects can also affect these projects such as the public by causing issues that are emerged from different political views, random amount of compensation and disputes during the land acquisition process, and complaints due to traffic congestion to the authorities. These problems may result in idling in projects until the issues are resolved. While there are complaints from the public, several participants suggest that highway projects do involve constructing alternative roads and working during the night due to traffic concerns, safety issues, and public perception. Furthermore, authorities, the other third-party that are indirectly involved with the highway projects, are suggested to influence the success of highway projects due to authorities' processing times of submittals. Unpredictable and slower than usual processing times might cause issues to highway projects such as idling and unnecessary rescheduling. In other words, public acceptance and efficient authorities are also factors that are affecting highway project success.

5. Conclusion

To promote the success of highway projects in Malaysia, this study identifies factors that are affecting highway project success by analyzing interview data with sixteen highway project managers. Through thematic analysis, the results identified 11 factors affecting the success of highway projects in Malaysia. The factors are: workflow for the design process, competencies of project managers, availability of workforce, availability of materials, availability of equipment, weather, site location, involvement from upper management, support from clients, public acceptance, and efficiency of authorities. These factors can be grouped into six categories: process, labor, material, equipment,

construction site, and third-party. Then, these categories can be divided into two groups: internal factors and external factors. These findings highlight the need to identify opportunities in avoiding factors that can negatively affect project success, especially the internal factors that are more actionable by project managers. Thus, the lesson of this study would help the industry to promote project success of highway projects in Malaysia. The key theoretical contribution of this research is by providing researchers and practitioners with a set of alternative factors that are affecting highway project success.

6. References

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